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CLAIMS

1. (Currently Amended) An electrode for use in an electrochemical cell system, comprising, based on the total weight of the electrode:

about 5 to about 95 wt. % of a support that is non-oxidizable at anodic potentials of greater than about 1.5 to less than about 4 volts;

about 5 to about 95 wt. % of a catalyst integrated with the support; and

up to about 50 wt. % of a proton conductive material integrated with the catalyst.

2. (Original) The electrode as in claim 1, comprising about 5 to about 15 wt. % of the support, about 85 to about 90 wt. % of the catalyst, and up to about 15 wt. % of the proton conductive material.

3. (Original) The electrode as in claim 2, comprising about 5 to about 10 wt. % of the support, about 85 to about 90 wt. % of the catalyst, and about 5 to about 10 wt. % of the proton conductive material.

4. (Cancelled)

5. (Original) The electrode as in claim 1, comprising about 20 to about 80 wt. % of the support, about 20 to about 80 wt. % of the catalyst, about 5 to about 25 wt. % of the proton conductive material.

6. (Original) The electrode as in claim 1, wherein the proton conductive material is selected from the group consisting of proton conducting ionomers and ion exchange resins.

7. (Original) The electrode as in claim 6, wherein the proton conducting ionomer comprises a complex of an alkali metal, an earth metal salt, or a protonic acid, and one or more polar polymers selected from the group consisting of polyether, polyesters, and polyimides.

8. (Original) The electrode as in claim 6, wherein the proton conducting ionomer comprises a complex of an alkali metal, an alkaline earth metal salt or a protonic acid and a network or crosslinked polar polymers selected from the group consisting of polyethers, polyesters and polyimides.

9. (Original) The electrode as in claim 6, wherein the ion exchange resin comprises a sulfonated hydrocarbon ion exchange resin or a sulfonated fluorocarbon ion exchange resin.

10. (Original) The electrode as in claim 1, wherein the support material is non-oxidizable at anodic potentials less than about 3 V.

11. (Original) The electrode as in claim 1, wherein the support material is selected from the group consisting of oxides, carbides, nitrides, carbon, conductive metals, niobium; zirconium, tantalum, titanium, iron, iron alloys, steels, stainless steel, nickel, nickel alloys, cobalt, cobalt superalloys, hafnium, tungsten, tungsten alloys, and mixtures comprising at least one the foregoing support materials.

12. (Currently Amended) The electrode as in claim 36~~11~~, wherein the ~~oxide is a~~ metal oxide is selected from the group consisting of aluminum oxide, zirconium oxide, titanium oxide, and tungsten oxide.

13. (Currently Amended) The electrode as in claim ~~11~~36, wherein the carbide is silicon carbide.

14. (Currently Amended) The electrode as in claim ~~11~~36, wherein the nitride is titanium nitride.

15. (Cancelled)

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16. (Original) The electrode as in claim 1, wherein the support material has a resistivity of less than about 270 microohm-centimeter.

17. (Original) The electrode as in claim 1, wherein the support material has a surface area of greater than about 25 meters^2/gram.

18. (Original) The electrode as in claim 1 wherein the catalyst material is selected from the group consisting of platinum, palladium, rhodium, carbon, gold, tantalum, tungsten, ruthenium, iridium, osmium, mixtures comprising at least one of the foregoing catalyst materials, and alloys comprising at least one of the foregoing catalyst materials.

19. (Cancelled)

20. (Original) The electrode as in claim 1, wherein the support material is in a particulate form.

21. (Currently Amended) A method of manufacturing an electrode for an electrochemical cell, comprising:

mixing a catalyst material and a support material that is non-oxidizable at anodic potentials of greater than about 1.5 to less than about 4 volts to form the electrode, wherein the support material is selected from the group consisting of metal oxides, carbides, nitrides, niobium, zirconium, tantalum, cobalt, cobalt superalloys, hafnium, tungsten, tungsten alloys, and mixtures comprising at least one the foregoing support materials; and

forming the mixture into an electrode.

22. (Original) The method as in claim 21, further comprising mixing a proton conductive material with the catalyst material and support material.

23. (Original) The method as in claim 21, further comprising applying a proton exchange material onto the mixed catalyst material and support material prior to forming the electrode.

24. (Cancelled)

25. (Currently Amended) ~~The method as in claim 24,~~ A method of manufacturing an electrode for an electrochemical cell, comprising:

coating or infiltrating preformed support material with a catalyst material, wherein the support material is non-oxidizable at anodic potentials of greater than about 1.5 to less than about 4 volts;

wherein the catalyst material further comprises a proton conductive material; and

wherein the support material is selected from the group consisting of oxides, carbides, diamond, nitrides, niobium, zirconium, tantalum, cobalt, cobalt superalloys, hafnium, tungsten, tungsten alloys, and mixtures comprising at least one the foregoing support materials.

26. (Currently Amended) ~~The method as in claim 24,~~ A method of manufacturing an electrode for an electrochemical cell, comprising:

coating or infiltrating preformed support material with a catalyst material, wherein the support material is non-oxidizable at anodic potentials of greater than about 1.5 to less than about 4 volts;~~further comprising~~ and

applying a proton exchange material to the coated support material.

27. (Currently Amended) In an electrochemical cell, a membrane electrode assembly, comprising:

a first electrode comprising, based on the total weight of the electrode, about 5 to about 95 wt. % of a support that is non-oxidizable at anodic potentials of greater than about 1.5 to less than about 4 volts, about 5 to about 95 wt. % of a catalyst integrated with the support, wherein the support material is selected from the group consisting of oxides, carbides, diamond, nitrides, niobium, zirconium, tantalum, cobalt, cobalt superalloys, hafnium, tungsten, tungsten alloys, and mixtures comprising at least one the foregoing support materials, and ~~up~~ about 1 to about 50 wt. % of a proton conductive material integrated with the catalyst;

a second electrode; and

a proton exchange membrane disposed between the first electrode and the second electrode.

28. (Original) The membrane electrode assembly as in claim 27, wherein the first electrode comprises about 5 to about 15 wt. % of the support, about 85 to about 90 wt. % of the catalyst, and up to about 15 wt. % of the proton conductive material.

29. (Original) The membrane electrode assembly as in claim 28, wherein the first electrode comprises about 5 to about 10 wt. % of the support material, about 85 to about 90 wt. % of the catalyst, and about 5 to about 10 wt. % of the proton conductive material.

30. (Cancelled)

31. (Original) The membrane electrode assembly as in claim 27, wherein the first electrode comprises about 20 to about 80 wt. % of the support material, about 20 to about 80 wt. % of the catalyst, about 5 to about 25 wt. % of the proton conductive material.

32. (Original) The membrane electrode assembly as in claim 27, wherein the first electrode comprises a non-oxidizable support material having a resistivity of less than about 5.48 microohm-cm.

33. (Currently Amended) An electrochemical cell system, comprising:

a first electrode that is non-oxidizable at anodic potentials of greater than about 1.5 to less than about 4 volts, wherein the electrode comprises, based on the total weight of the electrode, about 5 to about 95 wt. % of a support material, wherein the support material is selected from the group consisting of metal oxides, carbides, metal nitrides, niobium, zirconium, tantalum, cobalt, cobalt superalloys, hafnium, tungsten, tungsten alloys, and mixtures comprising at least one the foregoing support materials, about 5 to about 95 wt. % of a catalyst material disposed on the support material, and ~~up~~ about 1 to about 50 wt. % of a proton conductive material disposed on the support material and/or catalyst material;

a second electrode;

a membrane disposed between and in intimate contact with the first electrode and second electrode;

a first flow field in fluid communication with the first electrode opposite the membrane;

a second flow field in fluid communication with the second electrode opposite the membrane;

a water source in fluid communication with the first flow field; and

hydrogen removal means in fluid communication with the second flow field.

34. (Original) The electrochemical cell system as in claim 33, wherein the support material has a resistivity of less than about 270 microohm-centimeter.

35. (Original) The electrochemical cell system as in claim 33, wherein the support material has a surface area of greater than about 25 meters^2/gram.

36. (New) An electrode for use in an electrochemical cell system, comprising, based on the total weight of the electrode:

about 5 to about 95 wt. % of a support that is non-oxidizable at anodic potentials of greater than about 1.5 to less than about 4 volts, wherein the support material is selected from the group consisting of metal oxides, carbides, nitrides, and mixtures comprising at least one the foregoing support materials;

about 5 to about 95 wt. % of a catalyst integrated with the support; and

about 1 to about 50 wt. % of a proton conductive material integrated with the catalyst.

37. (New) An electrode for use in an electrochemical cell system, comprising, based on the total weight of the electrode:

about 5 to about 95 wt. % of a support that is non-oxidizable at anodic potentials of greater than about 1.5 to less than about 4 volts, wherein the support material is selected from the group consisting niobium, tantalum, cobalt, cobalt superalloys, hafnium, tungsten, tungsten alloys, and mixtures comprising at least one the foregoing support materials;

about 5 to about 95 wt. % of a catalyst integrated with the support; and

about 1 to about 50 wt. % of a proton conductive material integrated with the catalyst.

38. (New) The method as in claim 22, wherein the support material comprises an oxide.

39. (New) The method as in claim 21, wherein the support material is the support material is selected from the group consisting of carbides, nitrides, and mixtures comprising at least one the foregoing support materials.

40. (New) The electrode as in claim 1, wherein the support material is selected from the group consisting of carbides, nitrides, and mixtures comprising at least one the foregoing support materials.

41. (New) The electrode as in claim 1, wherein the support material is selected from the group consisting of diamond, niobium, zirconium, tantalum, cobalt, cobalt superalloys, hafnium, tungsten, tungsten alloys, and mixtures comprising at least one the foregoing support materials.

42. (New) The electrode as in claim 41, wherein the support material comprises diamond.

43. (New) An electrode for use in an electrochemical cell system, comprising, based on the total weight of the electrode:

about 5 to about 95 wt. % of a support that is non-oxidizable at anodic potentials of less than about 4 volts, wherein the support material is selected from the group consisting of carbides, nitrides, and mixtures comprising at least one the foregoing support materials;

about 5 to about 95 wt. % of a catalyst integrated with the support; and

up to about 50 wt. % of a proton conductive material integrated with the catalyst.